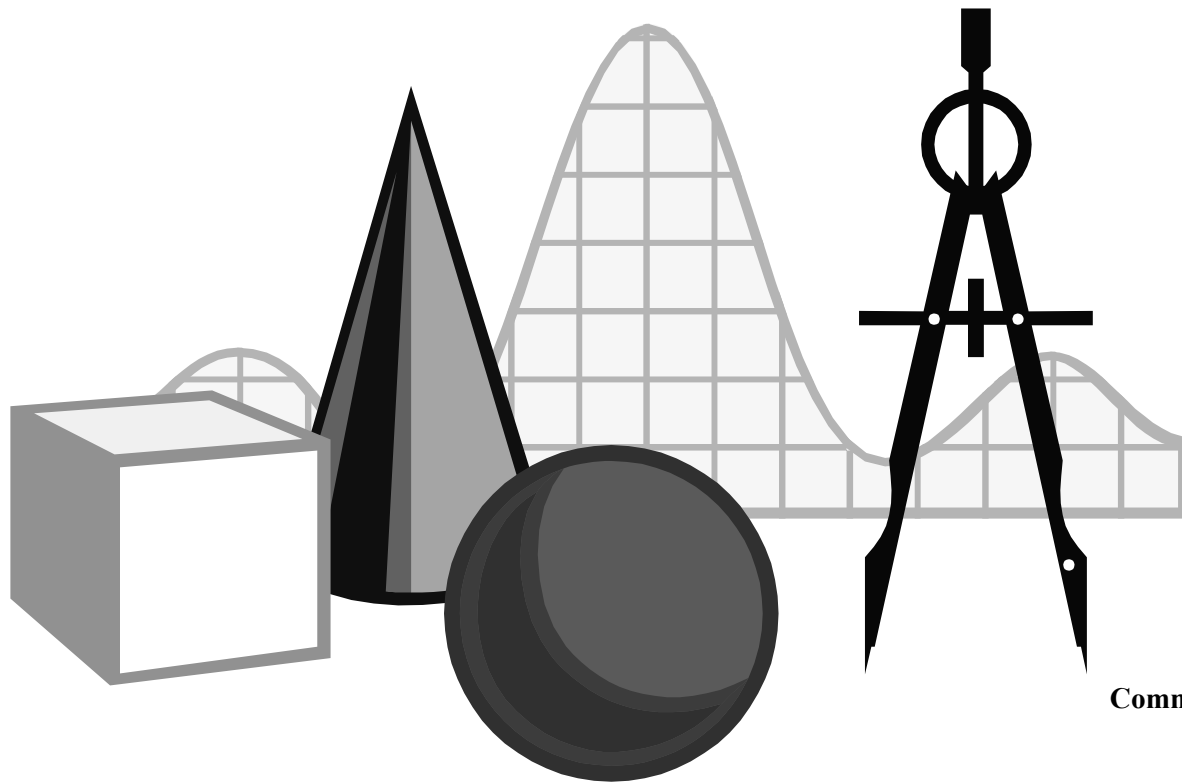


MATHEMATICS STANDARDS OF LEARNING CURRICULUM FRAMEWORK

Kindergarten



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Students in grades K–3 have a natural curiosity about their world, which leads them to develop a sense of number. Young children are motivated to count everything around them and begin to develop an understanding of the size of numbers (magnitude), multiple ways of thinking about and representing numbers, strategies and words to compare numbers, and an understanding of the effects of simple operations on numbers. Building on their own intuitive mathematical knowledge, they also display a natural need to organize things by sorting, comparing, ordering, and labeling objects in a variety of collections.

Consequently, the focus of instruction in the number and number sense strand is to promote an understanding of counting, classification, whole numbers, place value, simple fractions, number relationships (“more than,” “less than,” and “as many as”), and the effects of simple operations on numbers (fact families). These learning experiences should allow students to engage actively in a variety of problem-solving situations and to model numbers (compose and decompose), using a variety of manipulatives. Additionally, students at this level should have opportunities to observe, to develop an understanding of the relationship they see between numbers, and to develop the skills to communicate these relationships in precise, unambiguous terms.

K.1 The student, given two sets containing 10 or fewer concrete items, will identify and describe one set as having more, fewer, or the same number of members as the other set, using the concept of one-to-one correspondence.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> • A set is a collection of distinct elements or items. • A one-to-one correspondence exists when two sets have an equal number of items. • Strategies for developing the concept of one-to-one matching involve set comparisons without counting. Hands-on experiences in matching items between two sets by moving, touching, and aligning objects, using one-to-one correspondence, enable visual as well as kinesthetic comparisons of the number of items in the two sets. • Students can also use the strategy of counting to make comparisons between two sets without matching the sets, using one-to-one correspondence. 	<p>All students should</p> <ul style="list-style-type: none"> • Understand how quantities relate to each other, which leads to an understanding of how numbers are related to each other. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> • Match each member of one set with each member of another set, using the concept of one-to-one correspondence to compare the number of members between sets, where each set contains 10 or fewer items. • Compare and describe two sets of 10 or fewer items, using the terms <i>more</i>, <i>fewer</i>, and <i>the same</i>.

- K.2 The student, given a set containing 10 or fewer concrete items, will**
- tell how many are in the set by counting the number of items orally;**
 - select the corresponding numeral from a given set; and**
 - write the numeral to tell how many are in the set.**

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> Counting involves two separate skills: verbalizing the list of standard number words in order (“one, two, three,...”) and connecting this sequence with the items in the set being counted, using one-to-one correspondence. Association of number words with collections of objects is achieved by moving, touching, or pointing to objects as the number words are spoken. Objects may be presented in random order or arranged for easy counting. Kinesthetic involvement (e.g., tracing the numbers, using tactile materials, such as sand, sandpaper, carpeting, or finger paint) facilitates the writing of numerals. Articulating the characteristics of each numeral when writing numbers has been found to reduce the amount of time it takes to learn to write numerals. 	<p>All students should</p> <ul style="list-style-type: none"> Read and write numerals from 0 through 10. Understand that the total number of objects can be found by counting. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> Count orally the number of items in a set containing 10 or fewer concrete items, using one-to-one correspondence, and identify the corresponding numeral. Identify written numerals from 0 through 10 presented in random order. Select the numeral from a given set of numerals that corresponds to a set of 10 or fewer concrete items. Write the numerals from 0 through 10. Write a numeral that corresponds to a set of 10 or fewer concrete items.

K.3 The student, given an ordered set of three objects and/or pictures, will indicate the ordinal position of each item, first through third, and the ordered position of each item from left-to-right, right-to-left, top-to-bottom, and/or bottom-to-top.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> Understanding the cardinal and ordinal meanings of numbers is necessary to quantify, measure, and identify the order of objects. An ordinal number is a number that names the place or position of an object in a sequence or set (e.g., first, third). <i>Ordered position</i>, <i>ordinal position</i>, and <i>ordinality</i> are terms that refer to the place or position of an object in a sequence or set. The ordinal position is determined by where one starts in an ordered set of objects or sequence of objects. The ordinal meaning of numbers is developed by identifying and verbalizing the place or position of objects in a set or sequence (e.g., the student's position in line when students are lined up alphabetically by first name). 	<p>All students should</p> <ul style="list-style-type: none"> Use ordinal numbers to describe the order of items in a sequence. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> Identify the ordinal positions first, second, and third, using ordered sets of three concrete objects and/or pictures of such sets presented from <ul style="list-style-type: none"> left-to-right; right-to-left; top-to-bottom; and/or bottom-to-top.

K.4 The student will investigate and recognize patterns from counting by fives and tens to 30, using concrete objects and a calculator.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> • The patterns developed as a result of skip counting are precursors for recognizing numeric patterns, functional relationships, and concepts underlying money, time telling, and multiplication. Powerful models for developing these concepts include counters, hundred chart, and calculators. • Skip counting by fives lays the foundation for reading a clock effectively and telling time to the nearest five minutes, counting money, and developing the multiplication facts for five. • Skip counting by tens is a precursor for use of place value, addition, counting money, and multiplying by multiples of 10. • Calculators can be used to display the numeric patterns that result from skip counting. Use the constant feature of the four-function calculator to display the numbers in the sequence when skip counting by that constant. For example, when skip counting by fives, press $5 + 5 = = \dots$ to produce 5, 10, 15,.... 	<p>All students should</p> <ul style="list-style-type: none"> • Understand that skip counting can be used to count a collection of objects. • Describe patterns in skip counting and use those patterns to predict the next number or numbers in the skip counting sequence. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> • Group 30 or fewer objects together into sets of fives or tens and then count them by fives or by tens. • Investigate and recognize the pattern of counting by fives and tens, using 30 or fewer concrete objects. • Investigate and recognize the pattern of counting by fives and tens to 30, using a calculator.

K.5 The student will count forward to 30 and backward from 10.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none">Counting skills are essential components of the development of number ideas; however, they are only one of the indicators of the understanding of numbers.Counting forward by rote advances the child's development of sequencing. Students should count the natural numbers 1, 2, 3, 4,.... These are not to be confused with the whole numbers that begin with the integer zero.Counting backward by rote lays the foundation for subtraction. Students should count backward beginning with 10, 9, 8,... through ...3, 2, 1.Counting forward and backward leads to the development of counting on and counting back.	<p>All students should</p> <ul style="list-style-type: none">Use the correct oral counting sequence in both forward and backward counting situations.	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none">Count forward from 1 to 30.Count backward from 10 to 1.

A variety of contexts are necessary for children to develop an understanding of the meanings of the operations such as addition and subtraction. These contexts often arise from real-life experiences in which they are simply joining sets, taking away or separating from a set, or comparing sets. These contexts might include conversations, such as “How many books do we have altogether?” or “How many cookies are left if I eat two?” or “I have three more candies than you do.” Although young children first compute using objects and manipulatives, they gradually shift to performing computations mentally or using paper and pencil to record their thinking. Therefore, computation and estimation instruction in the early grades revolves around modeling and discussing a variety of problem situations to help students move from the concrete to the abstract and develop meaning for the operations and how they relate to each other.

In grades K–3, computation and estimation instruction focuses on

- relating the mathematical language and symbolism of operations to problem situations;
- understanding different meanings of addition and subtraction of whole numbers and the relation between the two operations;
- developing proficiency with basic addition, subtraction, and multiplication facts and related fact families;
- gaining facility in manipulating whole numbers to add and subtract and in understanding the effects of the operations on whole numbers;
- developing and using strategies and algorithms to solve problems and choosing an appropriate method for the situation;
- choosing, from mental computation, estimation, paper and pencil, and calculators, an appropriate way to compute;
- recognizing whether numerical solutions are reasonable;
- experiencing situations that lead to multiplication and division, such as equal groupings of objects and sharing equally; and
- performing initial operations with fractions and decimals.

K.6 The student will add and subtract whole numbers, using up to 10 concrete items.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none">• Whole numbers are 0, 1, 2, 3, 4, 5, 6, and so on.• Addition is the process of combining or joining sets.• Subtraction can be viewed as a “taking away” or “separating” process or as the difference between two sets.• Counting on from the larger set to determine the sum of the combined sets is a strategy for finding a sum.• Counting backward from the larger set to determine the difference between two sets is a strategy for subtraction.	<p>All students should</p> <ul style="list-style-type: none">• Understand that addition joins items together and that subtraction separates items out.	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none">• Combine two sets with known quantities in each set, and count the combined set to determine the sum, where the sum is not greater than 10 concrete items.• Remove, “take away,” or separate part of a set from a given set to determine the result of subtraction.

Measurement is important because it helps to quantify the world around us and is useful in so many aspects of everyday life. Students in grades K–3 should encounter measurement in many normal situations, from their daily use of the calendar and from science activities that often require students to measure objects or compare them directly, to situations in stories they are reading and to descriptions of how quickly they are growing.

Measurement instruction at the primary level focuses on developing the skills and tools needed to measure length, weight/mass, capacity, time, temperature, area, perimeter, volume, and money. Measurement at this level lends itself especially well to the use of concrete materials. Children can see the usefulness of measurement if classroom experiences focus on estimating and measuring real objects. They gain deep understanding of the concepts of measurement when handling the materials, making physical comparisons, and measuring with tools.

As students develop a sense of the attributes of measurement and the concept of a measurement unit, they also begin to recognize the differences between using nonstandard and standard units of measure. Learning should give them opportunities to apply both techniques and nonstandard and standard tools to find measurements and to develop an understanding of the use of simple U.S. Customary and metric units.

Teaching measurement offers the challenge to involve students actively and physically in learning and is an opportunity to tie together other aspects of the mathematical curriculum, such as fractions and geometry. It is also one of the major vehicles by which mathematics can make connections with other content areas, such as science, health, and physical education.

K.7 The student will recognize a penny, nickel, dime, and quarter and will determine the value of a collection of pennies and/or nickels whose total value is 10 cents or less.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> • Involvement in varied activities such as physically manipulating coins and making comparisons about their sizes, colors, and values is prerequisite to the skills of coin recognition and valuation. • Counting money helps students gain an awareness of consumer skills and the use of money in everyday life. • A variety of classroom experiences in which students manipulate physical models of money and count forward to determine the value of a collection of coins are important activities to ensure competence with using money. • Establishing a one-to-one correspondence between the number names and the items in a set of coins (pennies and/or nickels) is essential for an accurate count. 	<p>All students should</p> <ul style="list-style-type: none"> • Develop common referents for identifying pennies, nickels, dimes, and quarters. • Understand the value of a collection of coins whose value is 10 cents or less. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> • Describe the properties/characteristics (e.g., color, relative size) of a penny, nickel, dime, and quarter. • Identify a penny, nickel, dime, and quarter. • Count a randomly placed collection of pennies and/or nickels (or models of pennies and/or nickels) whose value is 10 cents or less, and determine the value of the collection.

K.8 **The student will identify the instruments used to measure length (ruler), weight (scale), time (clock: digital and analog; calendar: day, month, and season), and temperature (thermometer).**

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> Many experiences in measuring physical objects, using nonstandard and standard units of measure, help to develop an intuitive understanding of measurement and will help students connect a tool with its purpose in measuring. Selecting from among various measuring instruments and determining which can be used to solve various real-life problems are introduced at this level. A precursor to connecting tools to a type of measurement is an introduction to the concepts of length, weight, time, and temperature. 	<p>All students should</p> <ul style="list-style-type: none"> Identify an appropriate measuring tool for a given unit of measure. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> Identify a ruler as an instrument to measure length. Identify different types of scales as instruments to measure weight. Identify different types of clocks (analog and digital) as instruments to measure time. Identify the components of a calendar, including days, months, and seasons. Identify different types of thermometers as instruments used to measure temperature.

K.9 The student will tell time to the hour, using an analog or digital clock.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none">• Many experiences in relating time on the hour to daily routines and school schedules (e.g., catching the bus, lunch time, recess time, and resource time) help students develop personal referents for time.• Making sense of telling time to the nearest hour is reinforced when students recognize the positions of the hands on an analog clock and identify the corresponding time to the hour.	<p>All students should</p> <ul style="list-style-type: none">• Apply an appropriate technique, depending on the type of clock, to determine time to the nearest hour.	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none">• Tell time on an analog clock to the hour.• Tell time on a digital clock to the hour.

K.10 The student will compare two objects or events, using direct comparisons or nonstandard units of measure, according to one or more of the following attributes: length (shorter, longer), height (taller, shorter), weight (heavier, lighter), temperature (hotter, colder). Examples of nonstandard units include foot length, hand span, new pencil, paper clip, block.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> Length is the distance along a line or figure from one point to another. Height is the vertical length of a perpendicular to its base. Weight is a measure of the heaviness of an object. Temperature is the degree of hotness or coldness of an object (e.g., a body) or environment. Extensive opportunities are needed to gain the ability to compare the attributes of objects. 	<p>All students should</p> <ul style="list-style-type: none"> Compare and order objects according to their attributes. Develop an understanding of measuring with nonstandard and standard units of measure. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> Compare and describe lengths of two objects (as shorter or longer), using direct comparison or nonstandard units of measure (e.g., foot length, hand span, new pencil, paper clip, block). Compare and describe heights of two objects (as taller or shorter), using direct comparison or nonstandard units of measure (e.g., book, hand span, new pencil, paper clip, block). Compare and describe weights of two objects (as heavier or lighter), using direct comparison or nonstandard units of measure (e.g., book, cubes, new pencil, paper clip, block). Compare and describe temperatures of two objects or environment (as hotter or colder), using direct comparison.

Children begin to develop geometric and spatial knowledge before beginning school, stimulated by the exploration of shapes and structures in their environment. Geometric ideas help children systematically represent and describe their world as they learn to represent two- and three-dimensional shapes through drawing, block constructions, dramatization, and verbal language.

The focus of instruction at this level is on

- observing, comparing, and investigating three-dimensional objects and their two-dimensional faces;
- sorting objects and ordering them directly by comparing them one to the other;
- describing, comparing, sorting, and classifying shapes; and
- exploring symmetry, congruence, and transformation.

In the primary grades, children begin to develop basic vocabulary related to these shapes but do not develop precise meanings for many of the terms they use until they are thinking beyond Level 2 of the van Hiele theory (see below).

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)

K.11 The student will identify, describe, and draw two-dimensional (plane) geometric figures (circle, triangle, square, and rectangle).

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> An important part of the geometry strand in grades K through 2 is the naming and describing of shapes. Children move from their own vocabulary and begin to incorporate conventional terminology as the teacher uses geometric terms. A plane geometric figure is any two-dimensional closed shape. Circles and polygons are examples of plane geometric figures. The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding. <ul style="list-style-type: none"> Level 0: Pre-recognition. Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons. Level 1: Visualization. Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same (e.g., “I know it’s a rectangle because it looks like a door, and I know that a door is a rectangle.”) Level 2: Analysis. Properties are perceived, but are isolated and unrelated. Students should recognize and name properties of geometric figures (e.g., “I know it’s a rectangle because it is closed; it has four sides and four right angles.”). <p>continued</p>	<p>All students should</p> <ul style="list-style-type: none"> Use their knowledge of two-dimensional figures to help them systematically represent and describe their world. Develop an understanding of the shapes of geometric figures by using various methods. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> Identify a circle, triangle, square, and rectangle. Describe the properties of triangles, squares, and rectangles, including number of sides and number of corners. Describe a circle. Draw a circle, triangle, square, and rectangle.

K.11 The student will identify, describe, and draw two-dimensional (plane) geometric figures (circle, triangle, square, and rectangle).

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<p>continued</p> <ul style="list-style-type: none"> • A polygon is a geometric figure that <ul style="list-style-type: none"> – has sides that are straight; – is simple (its sides do not cross); – is closed; and – is two-dimensional (it lies in a plane). • A triangle is a polygon with three angles and three sides. Children should be shown different types of triangles such as equilateral, isosceles, scalene, right, acute, and obtuse; however, they are not expected to name the various types. • A quadrilateral is a polygon with four sides. • A rectangle is a quadrilateral with four right angles. • A square is a rectangle with all four sides of equal length. • A circle is a closed curve with all points in one plane and the same distance from a fixed point (the center). • Presentation of triangles, rectangles, and squares should be made in a variety of spatial orientations so that students do not develop the common misconception that triangles, rectangles, and squares must have one side parallel to the bottom of the page on which they are printed. 		

K.12 The student will describe the location of one object relative to another (above, below, next to) and identify representations of plane geometric figures (circle, triangle, square, and rectangle) regardless of their position and orientation in space.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> Representations of circles, squares, rectangles, and triangles can be found in the students' environment at school and at home. Students should have opportunities to identify/classify things in their environment by the type of shape those things represent. Children are often confused when a shape such as a square is rotated: they frequently refer to the rotated square as a diamond. Clarification needs to be ongoing — i.e., a square is a square regardless of its location in space; there is no such geometric shape as a diamond. Geometric manipulatives that can be used to combine plane geometric figures to create familiar shapes are <ul style="list-style-type: none"> – tangrams; – attribute blocks; – pattern blocks; – power blocks; – relational attribute blocks; and – transformations (slides, flips, turns) on shapes, which can be applied to change the orientation of the shape. 	<p>All students should</p> <ul style="list-style-type: none"> Use a variety of skills that relate to direction, distance, and position in space in order to enhance their navigation skills. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> Identify pictorial representations of a circle, triangle, square, and rectangle, regardless of their position and orientation in space. Describe the location of one object relative to another, using the terms <i>above</i>, <i>below</i>, and <i>next to</i>.

K.13 The student will compare the size (larger, smaller) and shape of plane geometric figures (circle, triangle, square, and rectangle).

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> • Early experiences with comparing and sorting shapes assist students in analyzing the characteristics and properties of two-dimensional geometric shapes. • Attribute blocks, relational attribute blocks, power blocks, and tangrams are among the manipulatives that are particularly appropriate for sorting and comparing size. 	<p>All students should</p> <ul style="list-style-type: none"> • Develop strategies to sort and/or group plane geometric figures and begin to refine the vocabulary used to explain their strategies. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> • Compare and group plane geometric figures (circle, triangle, square, and rectangle) according to their relative sizes (larger, smaller). • Compare and group plane geometric figures (circle, triangle, square, and rectangle) according to their shapes.

Students in the primary grades have a natural curiosity about their world, which leads to questions about how things fit together or connect. They display their natural need to organize things by sorting and counting objects in a collection according to similarities and differences with respect to given criteria.

The focus of probability instruction at this level is to help students begin to develop an understanding of the concept of chance. They experiment with spinners, two-colored counters, dice, tiles, coins, and other manipulatives to explore the possible outcomes of situations and predict results. They begin to describe the likelihood of events, using the terms *impossible*, *unlikely*, *equally likely*, *more likely*, and *certain*.

The focus of statistics instruction at this level is to help students develop methods of collecting, organizing, describing, displaying, and interpreting data to answer questions they have posed about themselves and their world.

K.14 The student will gather data relating to familiar experiences by counting and tallying.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> • Data are pieces of information collected about people or things. The primary purpose of collecting data is to answer questions. • Tallying is a method for gathering information. Tally marks are used to show how often something happens or occurs. Each tally mark represents one occurrence. Tally marks are clustered into groups of five, with four vertical marks representing the first four occurrences and the fifth mark crossing the first four on a diagonal to represent the fifth occurrence. • When data are presented in an organized manner, students can describe the results of their investigation (i.e., identifying parts of the data that have special characteristics, including categories with the greatest, the least, or the same). • In the process of gathering data, students make decisions about what is relevant to their investigation (e.g., when collecting data on their classmates' favorite pets, deciding to limit the categories to common pets). • When students begin to collect data, they recognize the need to categorize, which helps develop the understanding of "things that go together." Categorical data is used when constructing pictorial graphs and bar graphs. 	<p>All students should</p> <ul style="list-style-type: none"> • Pose questions and gather data about themselves and their surroundings. • Understand how data are collected and presented in an organized manner by counting and tallying. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> • Gather data on given categories by counting and tallying (e.g., favorites, number of days of various types of weather during a given month, types of pets, types of shoes).

K.15 The student will display objects and information, using object graphs, pictorial graphs and tables.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> Pictorial graphs are graphs that use pictures to show and compare information. A key is often used to indicate what each picture represents (e.g., one picture of a dog represents five dogs). Object graphs are graphs that use concrete materials to represent the categorical data that are collected (e.g., cubes stacked by the month, with one cube representing the birthday month of each student). Tables are an orderly arrangement of data in which the data are arranged in columns and rows in an essentially rectangular format. Tables may be used to display some type of numerical relationship or organized lists (e.g., input/output functions, tables showing one candy costs five cents and two candies cost 10 cents). Students represent data to convey results of their investigations at a glance, using concrete objects, pictures, and numbers to give a “picture” of the organized data. When data are displayed in an organized manner, children can describe the results of their investigations. Graphs can be used to make connections between mathematics and social studies and/or science (e.g., job areas and the different people that work in these areas: health — doctors and nurses; education — teachers and principals). 	<p>All students should</p> <ul style="list-style-type: none"> Understand that data can be represented using concrete objects, pictures, and graphs. Understand that different types of representations emphasize different things about the same data. Understand that pictorial graphs use pictures to show and compare information; object graphs use concrete materials to represent categorical data; and tables can be used to show an orderly arrangement of data in columns and rows. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> Display data by arranging concrete objects into organized groups to form a simple object graph. Display data, using pictorial representations of the data to form a simple pictorial graph (e.g., a picture graph of the types of shoes worn by students on a given day). Display information in tables, either in rows or columns (e.g., a table showing the number of bunnies in one column and the number of ears the bunnies have in another, or a table showing the time schedule for classroom activities).

K.16 The student will investigate and describe the results of dropping a two-colored counter or using a multicolored spinner.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> The concept of experimental probability is introduced through informal activities such as dropping a two-colored counter (usually a chip that has a different color on each side) or using a multicolored spinner (a circular spinner that is divided equally into two, three, four, or more equal “pie” parts where each part is filled with a different color). Answering questions about the likelihood of events begins at this level (i.e., “What is more likely?” or “What is less likely?”). Hands-on experimentation with two-colored counters and spinners helps children understand the likelihood of an event. Early probability investigations help students learn to enjoy and appreciate the value of probability. Through discussion, students may realize that a particular outcome is dependent upon the given situation. 	<p>All students should</p> <ul style="list-style-type: none"> Develop an understanding of chance (likelihood of an event) through informal investigations with spinners and two-colored counters. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> Conduct investigations of probability through hands-on activities such as dropping a two-colored counter or using a multicolored spinner. Describe verbally, pictorially, and/or with tally marks the outcome of dropping a two-colored counter or using a multicolored spinner (e.g., the number of times the red side of the counter landed up compared to the number of times the counter was dropped).

Stimulated by the exploration of their environment, children begin to develop concepts related to patterns, functions, and algebra before beginning school. Recognition of patterns and comparisons are important components of children's mathematical development.

Students in kindergarten through third grade develop the foundation for understanding various types of patterns and functional relationships through the following experiences:

- sorting, comparing, and classifying objects in a collection according to a variety of attributes and properties;
- identifying, analyzing, and extending patterns;
- creating repetitive patterns and communicating about these patterns in their own language;
- analyzing simple patterns and making predictions about them;
- recognizing the same pattern in different representations;
- describing how both repeating and growing patterns are generated; and
- repeating predictable sequences in rhymes and extending simple rhythmic patterns.

The focus of instruction at the primary level is to observe, recognize, create, extend, and describe a variety of patterns in the real world. These students will experience and recognize visual, kinesthetic, and auditory patterns and develop the language to describe them orally and in writing as a foundation to using symbols. They will use patterns to explore mathematical and geometric relationships and to solve problems, and their observations and discussions of how things change will eventually lead to the notion of functions and ultimately to algebra.

K.17 The student will sort and classify objects according to similar attributes (size, shape, and color).

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none">• To classify is to arrange or organize a set of materials according to a category or attribute (a quality or characteristic of a thing).• General similarities and differences among items are easily observed by children entering kindergarten, who are able to focus on any one attribute. The teacher's task is to move students toward a more sophisticated understanding of classification in which two or more attributes connect or differentiate sets, such as those found in nature (e.g., leaves with different colors and different shapes).	<p>All students should</p> <ul style="list-style-type: none">• Understand that the same set of objects can be sorted and classified in different ways.	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none">• Sort objects into appropriate groups (categories) based on one attribute, such as size, shape, or color.• Classify sets of objects into three groups (categories) of one attribute (e.g., for size — small, medium, and large).

K.18 The student will identify, describe, and extend a repeating relationship (pattern) found in common objects, sounds, and movements.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
<ul style="list-style-type: none"> Pattern recognition is a fundamental cornerstone of mathematics, particularly algebra. Pattern recognition and the extension of the pattern allows students to make predictions. The simplest types of patterns are repeating patterns. The patterns can be oral, such as the refrain in “Old MacDonald’s Farm” (“e-i-e-i-o”), or physical with clapping and snapping patterns, or combinations of both, such as is found in songs like the “Hokey Pokey.” In each case, students need to identify the basic unit of the pattern and repeat it. Opportunities to create, recognize, describe, and extend repeating patterns are essential to the primary school experience. Sample repeating patterns (repeating the basic unit) are <ul style="list-style-type: none"> – ABABABAB; – ABCABC; – AABBAABBAABB; – AABAAB; – AABCAABC; and – ABACABAC. 	<p>All students should</p> <ul style="list-style-type: none"> Understand that patterns are a way to recognize order and organize their world and to predict what comes next in an arrangement. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> Observe and identify the basic repeating pattern found in repeating patterns of common objects, sounds, and movements that occur in real-life situations, where there are four or fewer elements in the basic repeating pattern. Describe the basic repeating pattern found in a repeating pattern, where there are four or fewer elements in the basic repeating pattern. Extend a repeating pattern by adding at least two repetitions to the pattern.